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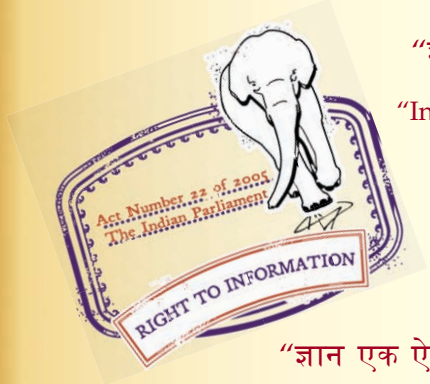

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CODE OF PRACTICE FOR PACKING AND PACKAGING OF OPTICAL AND MATHEMATICAL INSTRUMENTS AND COMPONENTS

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CODE OF PRACTICE FOR PACKING AND PACKAGING OF OPTICAL AND MATHEMATICAL INSTRUMENTS AND COMPONENTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 3 September 1969, after the draft finalized by the Optical and Mathematical Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Adequate and effective packing of instruments and their components in order to safeguard against any possible damage during transit and storage before they are used is as important as their efficient and successful production for satisfactory performance. Instruments and their components, which are precision stores, are required to be delivered to the users in perfect serviceable condition and may have to be transported over long distances using various means of transport by land, sea or air. In addition, they may be stored before use under adverse climatic conditions for long periods before taken into use. It is not generally possible to predict in advance at the time of actual manufacture what particular career in terms of storage, handling, transportation and climatic conditions any particular instrument or component will undergo before it reaches the user. It is, therefore, essential that packing, packaging and storage of these precision stores should be such that they can withstand satisfactorily all possible hazards due to climatic and environmental conditions that they may come across during transport and storage.

0.3 Instruments and materials used in their manufacture deteriorate in storage in tropical and sub-tropical regions of the globe where conditions of high temperature and high humidity prevail, often with attendant nocturnal condensations of atmospheric water vapour on them. In addition, locational climatic factors like exposure to high velocity winds, dust and sand storms, ultra-violet solar radiation in desert areas, saline atmosphere in coastal regions and at sea, micro-organisms, insects, termites, rodents, lizards, snakes and cockroaches in jungle areas or areas with profuse vegetation are other contributory factors that lead to deterioration of instruments and their materials. Further, mechanical hazards due to handling and transportation by various means over different terrains resulting in shock and vibration to packages and their contents are equally important factors that need attention during packing and packaging of instruments and components. Thus, the factors responsible for deterioration of packed

instruments and components may be broadly classified as follows:

a) Biological agents, and

b) Climatic and environmental factors.

0.3.1 Biological agents include bacteria, moulds and fungi, insects, termites, rodents, lizards, snakes and cockroaches which are responsible for the deterioration of stores, such as cotton, jute, woollen goods, paper, timber and leather which are generally eaten up by insects, termites and animals, while in the case of optical instruments, micro-organisms are responsible for the obscuration of vision through the instrument by the formation of mould growth on optical glass surfaces. The nature and extent of deterioration varies with the condition and type of materials.

0.3.2 Climatic and environmental factors lead to various types of deterioration. For instance, high ambient temperatures result in softening of lutings and cements, heat-ageing of materials, thinning down and consequent flowing away of lubricants, deterioration of plastic materials and paints, the latter particularly due to the actinic effects of the ultra-violet content of solar radiation, fall in insulation properties of electrical materials and so on. If the ambient temperatures are very low, then plastics and rubbers become hard and brittle, sealing compounds dry out and develop cracks in joints, lubricants may cease to function and jam the moving parts. High relative humidities combined with fairly high atmospheric temperatures are conducive to the proliferation and growth of micro-organisms, swelling of higroscopic materials and their subsequent deterioration leading to mechanical failures, acceleration of metallic corrosion and rusting, decomposition of certain types of varnishes and plastic materials, fogging and filming of optical instruments due to breathing during diurnal changes in temperature and humidity, drop in insulation resistance, cracking and flash-over of electrical components and so on. Dust and sand result in abrasive action over metallic components as well as clogging of moving parts, while saline atmosphere may lead to rapid corrosion and rusting as well as deposition of damp layers over instruments and components. High velocity winds cause vibration and excessive movement. Mechanical hazards due to handling and transport by different means will result in subjecting the instruments, their components as well as their packages to bump, their vibration and shock which may result in mechanical and structural failures.

1. SCOPE

1.1 This standard specifies the general guiding principles and methods for packing and packaging of optical and mathematical instruments and components.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Barrier — Material providing a physical shield against the ingress of elements which cause deterioration.

2.2 Carton — Container fabricated from carton (paper) board.

2.3 Container — A generic term for any receptacle which holds, restrains or encloses an item or items to be stored or transported.

2.4 Cushion — Material applied to mitigate shock or to protect surface from abrasion and to position an item in a package or both.

2.5 Desiccated Package — A package which includes in its construction either a hermetically sealed container or a continuous barrier in the form of material, water vapour permeability of which is not higher than one gram of water vapour per square metre in 24 hours when measured at 37·8°C with relative humidity difference of 90 percent.

2.6 Non-waterproof Package — A package in which no precautions are taken to prevent the ingress of water.

2.7 Pack, Package or Packet — The resultant product of a complete series of packaging operations on the product.

2.8 Packaging — The art of and the operations involved in the preparation of supplies for carriage, storage and delivery to the consumer. The term embraces preservation, identification and packing.

2.9 Packing — All those stages of packaging by which supplies are enveloped in wrapping placed in containers or both or otherwise secured.

2.10 Preservation — The cleaning and drying of an item and the application of a suitable temporary protective, where necessary, to maintain the item in prime condition.

2.11 Storage — A stage of packaging by which the supplies are packaged and preserved so as to preserve the supplies from effects of atmospheric elements till they are required for use.

2.12 Waterproof Package — A package which includes in its construction a continuous barrier which is impervious to water.

2.13 Water Vapour-Proof Package — A package which includes in its construction a sealed watertight barrier transmitting not more than one gram of water vapour per square metre in 24 hours when measured at 37·8°C and with a relative humidity difference of 90 percent.

3. FACTORS GOVERNING CHOICE OF PACKING MATERIALS AND PACKING PROCESSES

3.1 Packing materials and method of packing of any article shall be carefully selected to ensure that it will withstand the hazards of handling, transportation and storage. The primary factors which shall be considered before selecting the materials and methods are given below.

3.1.1 The destination may be:

a) local,

b) inland, or

c) overseas.

While considering destination, the ultimate destination for consumption and not merely the temporary, intermediate or transit destination shall be taken into consideration.

3.1.2 The kind of transport and conditions of handling and storage during transit shall be taken into consideration. These shall include:

a) type of transport available, that is, road, rail, sea or air; if by road whether by motor trucks, bullock carts, pack animals and so on;

b) probable number of loadings and unloadings; and

c) probable adverse conditions during loading, transportation and storage.

3.1.3 Climatic conditions of journey, storage and use shall also be taken into consideration. These shall include:

a) probable limits of temperature and effects of heat and sunlight;

b) humidity and dew conditions;

c) likelihood of exposure to rainfall, floods, snow or dust and sandstorms; and

d) presence of corrosive gases or vapours in the atmosphere.

3.1.4 Conditions of use and distribution shall be taken into consideration, that is,

a) whether distribution will be direct to users in original packs or whether packages have to be broken down before issue, and

b) whether the container is required for storage of the article when in use.

3.1.5 Character of the article, that is, its shape, fragility, surface finish or corrodability shall determine the type of interior packing and the protection required, such as the type of wrapping materials to be used and the

method of interior packing. Size, shape, nature, weight of the article and the number of units to be packed shall determine the outer container.

3.1.6 Wherever possible, it is recommended to pack instruments and components in light weight container or package or both consistent with the weight of equipment so that the package may be handled safely.

3.2 Packing Materials — The main criteria for selecting the packing materials shall be that they shall not have any deleterious effect on the items to be packed. A list of suggested packing materials is given in Appendix A and recommendations regarding the use of desiccants are given in Appendix B.

4. CLASSIFICATION OF PRIMARY PACKAGES

4.1 As far as degree of barrier protection against water and water vapour is concerned, the primary packages shall be classified as under:

a) *Non-waterproof Packages* — These provide protection against mechanical damage only. This method is suitable for such items only which either from their very nature are not required to be protected against water and humidity or for which this protection is uneconomical or which have already received such protection by paint or by a highly resistant temporary preservative.

b) *Waterproof Packages* — These include a barrier which is sufficiently impervious to water. This method is suitable for items which might be spoiled by water but which are not affected by water vapour or have been suitably protected against it by a contact preservative.

c) *Water Vapour-Proof Packages* — These include a sealed barrier which is sufficiently impervious to water vapour in addition to being waterproof. This method is suitable for items which, in addition to protection against water, require protection against water vapour and for which protection may be suitably achieved by application of preservatives.

d) *Desiccated Packages* — In addition to water vapour-proof sealed barrier, these include a desiccant inside the hermetically or air-tight sealed container so as to maintain relative humidity below 40 percent. This method is suitable for items which require a very high degree of protection against humidity and which are unsuited to the use of contact preservatives.

4.2 The method of packing selected, as far as protection against water and water vapour is concerned, shall therefore take into consideration the nature of the item and the type of preservative which has been or may be given to it before packing. Further, where a preservative used itself acts in the vapour phase, sealing of the package may be necessary to prevent

loss of preservative concentration through outward diffusion. In addition some form of sealing of the outer containers may be necessary against moisture in order to protect the cushioning materials which might otherwise deteriorate, thus losing their cushioning value.

5. BASIC PACKAGING METHODS

5.1 A series of detailed primary packaging methods is in vogue, each of which details precisely the type of materials to be used in the construction of packages. The series is designated as ' Basic Packaging Methods ' and is given in Appendices C to F for four classes of packages as follows:

a) Non-waterproof package (series A),
b) Waterproof package (series B),
c) Water vapour-proof package (series C), and
d) Desiccated package (series D).

6. PACKAGE DESIGN REQUIREMENTS AND LEVELS OF PROTECTION

6.1 The protection to be provided by any specific package depends upon the severity of the risks to which it is expected to be subjected during transport and storage. Apart from exceptional instances, it may be specified by one or other of the following levels of protection. Having decided the level of protection, the conditions of primary packages shall be determined from the series (*see* **4.1** and **5.1**) taking the following specific requirements into consideration:

a) *Full Protection* — The design of the package shall be such as to maintain the contents in a serviceable condition during transport to any destination, and to maintain this condition for a designated period of not less than two years.
b) *Restricted Protection* — The design of the package shall be such as to afford desired climatic protection to the supply and maintain the contents in a serviceable condition during transport within the country of origin.
c) *Trade Package* — The pack used by the manufacturer for normal commercial deliveries of his products within the country of origin.

7. TESTS

7.1 Type Approval Tests — These shall in general be carried out on the samples of first batch only and it shall not be necessary to carry out further tests as long as there is no change in design, production techniques or materials used for packaging.

For the purpose of these tests three identical packages each of full protection and restricted protection type shall be subjected to the following tests in accordance with the severity given in Table 1. The sequence and methods of tests to be followed are as given in **7.1.1** to **7.1.9**. The packages and their contents shall not show any deterioration after these tests.

7.1.1 *Cold Test* — Each package shall be placed in a chamber with the lid or bung uppermost and subjected to the test specified in Table 1.

7.1.2 *Dry Heat Test* — Each package shall be placed in a chamber with the lid or bung uppermost and subjected to the test specified in Table 1.

7.1.3 *Bump Test* — Each package, positioned as normally indicated on the package for transit, shall be subjected to bumps for the duration given in Table 1 consisting of free drops through a height of 25 mm at 2 to 4 bumps per second.

7.1.4 *First Drop Test* — Each package shall be subjected to free vertical falls on to a steel plate of 6 mm thickness mounted (wet floated and bolted down) on a fully set concrete block 450 mm thick in the manner given below. For packages weighing up to and including 70 kg, the height of drops shall be as indicated in Table 1 (measured from the lowest point of package):

	Rectangular Package (*see* Fig. 1)	*Cylindrical Package* (*see* Fig. 2)
a) *Flat drop*	Once on to each face in sequence *C, D, A, B, E, F*	Once each on to lines *ae*, *bf*, *cg*, *dh*, base (*efgh*), head (*abcd*) in the sequence given
b) *Corner drop*	Once on the black corner (*CBF*), once on the red corner (ADE)	Not applicable
c) *Edge drop*	Not applicable	Once on to point *x*, and once on to point *y*

NOTE — One of the three packages of each type shall be withdrawn from the tests and examined fully including the condition of its contents. The remaining packages under test shall be subjected to further tests unless it is obvious that the packages shall not survive further tests.

7.1.5 *Damp Heat Test* — The packages shall be subjected to the following cycle:

First part — 12 hours at 40°C and 95 to 100 percent relative humidity.

Second part — 12 hours cooling with condensation during which period shall be kept at room temperature.

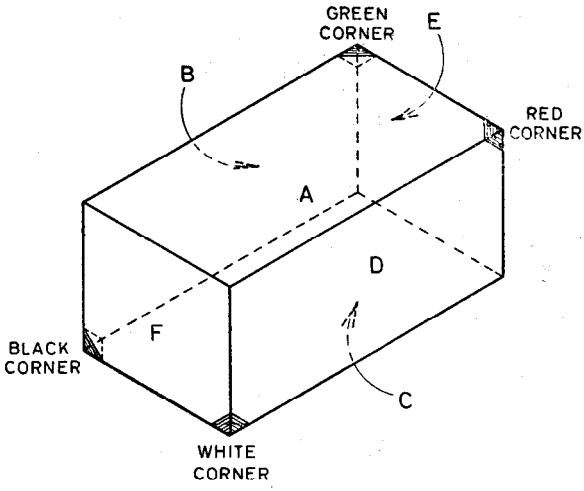

FIG. 1 RECTANGULAR PACKAGE

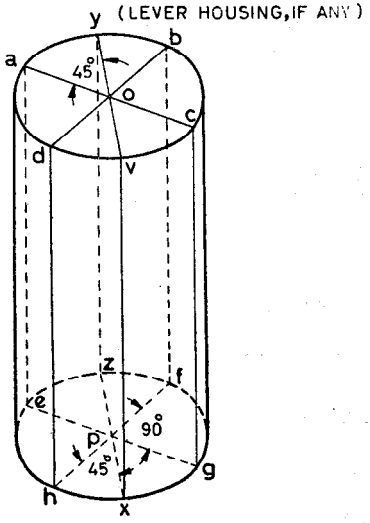

FIG. 2 CYLINDRICAL PACKAGE

7.1.6 *Driven Rain Test* — This test shall be carried out in accordance with the details given in **15** of IS : 2352-1963*.

NOTE — One more package of each type shall be drawn from the test and examined fully, including the condition of its contents. The remaining packages shall be subjected to further tests unless it is obvious that the packages shall not survive further tests.

7.1.7 *Vibration Test* — The packages shall be rigidly mounted on a vibration table and vibrated in three directions which shall be mutually at right angles throughout the range of vibration for a period of 15 minutes in each direction.

7.1.8 *Second Drop Test* — The packages shall be subjected to a free vertical fall on to a steel plate of 6 mm thickness mounted (wet floated and bolted down) on a fully set concrete block 450 mm thick in the manner given below. For packages weighing up to and including 70 kg the height of drops shall be as indicated in Table 1 (measured from the lowest point of package):

	Rectangular Package (*see* Fig. 1)	*Cylindrical Package* (*see* Fig. 2)
a)	Once on to face *A*	Once on to head (*abcd*)
b)	Once on to white corner (*CDF*)	Once on to point *z*
c)	Once on to green corner (*ABE*)	Once on to point *v*

7.1.9 *Salt Spray Test* — This test shall be carried out on the full protection package only in accordance with **10** of IS : 2352-1963*.

NOTE — The last packages shall be finally examined fully, including the condition of its contents, after the completion of all tests.

7.1.10 Three identical samples of trade package shall be subjected only to tests at **7.1.4**, **7.1.7** and **7.1.8**. One package shall be withdrawn after each of these tests and examined fully, including the condition of its contents.

7.2 Performance Test — Every package whether full protection, restricted protection or trade package shall be subjected to one vertical drop test with the lid or bung uppermost, from a height as indicated below, on to a steel plate of 6 mm thickness mounted (wet floated and bolted down) on a fully set concrete block 450 mm thick:

Full protection	1 350 mm
Restricted protection	900 mm
Trade package	600 mm

After the test, each package shall be given vigorous jerk to observe whether anything is rattling inside the package. In case there is any rattling, the package shall be declared as failed.

*Procedure for basic climatic and durability tests for optical instruments.

TABLE 1 REQUIREMENTS FOR TESTING OF PACKAGES

(*Clauses* 7.1 *to* 7.1.4 *and* 7.1.8)

Sl No.	Test	Full Protection	Restricted Protection	Trade Package
1	Cold test*	−10°C for 48 hours	0°C for 48 hours	—
2	Dry heat test	55°C for 48 hours	40°C for 48 hours	—
3	Damp heat test	40°C and 95 to 100 percent relative humidity	40°C and 95 to 100 percent relative humidity	—
4	Driven rain test	Spraying for one hour at ambient temperature	Spraying for half an hour at ambient temperature	—
5	Salt spray test	72 hours	—	—
6	Vibration test	1 to 15 cycles per second with an amplitude of ±1·5 mm	1 to 15 cycles per second with an amplitude of ±1·5 mm	1 to 15 cycles per second with an amplitude of ±1·5 mm
7	Bump test	Drop of 25 mm at 2 to 4 bumps per second for one hour	Drop of 25 mm at 2 to 4 bumps per second for half an hour	Drop of 25 mm at 2 to 4 bumps per second for 15 minutes
8	Drop test	*Weight of Package (Gross),* kg / *Height in mm*: Up to 10 — 1 050; Over 10 and up to 25 — 900; Over 25 and up to 70 — 750	*Weight of Package (Gross),* kg / *Height in mm*: Up to 10 — 750; Over 10 and up to 25 — 600; Over 25 and up to 70 — 450	*Weight of Package (Gross),* kg / *Height in mm*: Up to 10 — 600; Over 10 and up to 25 — 450; Over 25 and up to 70 — 300

*When agreed to between the purchaser and the manufacturer, the special severity for full protection shall be −40°C.

APPENDIX A

(*Clause* 3.2)

PACKING MATERIALS

A-1. The following groups of packing materials are available in the industry for packing and packaging of delicate instruments and equipment:

a) Wrapping materials, such as neutral tissue paper for optical components, tissue paper, grease paper, brown paper, etc;

b) Cushioning materials, such as cotton waste, cotton, paper cutting, straw felt, corrugated cardboard, wood wool, etc;

c) Cardboard containers and cartons;

d) Tapes for closing and sealing;

e) Textile cloths and bags;

f) Cordages, lines and twines;

g) Plastic materials;

h) Wooden box, metal containers, etc;

j) Preservatives, such as grease, paint, etc; and

k) Desiccants.

APPENDIX B

(Clause 3.2)

RECOMMENDATIONS REGARDING USE OF DESICCANTS

B-1. The minimum quantity of basic desiccant to be included in a package shall be calculated from the following formula:

$$W = \frac{ARM}{6} + \frac{D}{4}$$

where

W = weight of the basic desiccant in kilograms,

A = area of the water vapour barrier in square metres,

R = water vapour transmission rate in grams per square metre per 24 hours,

M = required life of the pack in months, and

D = weight in kilograms of hygroscopic packing or blocking material or instrument cases, etc, within the barrier.

Where hermetically sealed metal containers are used,

$$W = \frac{V}{100} + \frac{D}{2}$$

where

W = weight of the basic desiccant, in kilograms,

V = volume in cubic metres of free space inside the container, and

D = weight in kilograms of hygroscopic packing or blocking material or instrument cases, etc, within the barrier.

B-1.1 Generally the desiccant used is silicagel (hydrated silicondioxide) which has a property of absorbing moisture to the extent of 60 percent of its weight. Another advantage is that the fully moisture laden silicagel may be reconditioned that is the absorbed moisture may be driven off by heating it to 150°C for three to four hours. Five to ten percent of the desiccant is dyed with 30 percent Cobalt chloride solution which acts as an indicator. The dyed portions will be blue when fully reconditioned and will turn pink when moisture is absorbed. By means of this indicator it may immediately be known whether the desiccant is to be re-conditioned.

APPENDIX C

(*Clause* 5.1)

METHODS OF NON-WATERPROOF PACKAGING (SERIES A)

C-1. Non-waterproof Packages Without Temporary Protective

a) Supplies loose or in bundles.

b) Supplies loose or in bundles with protection against physical damage.

c) Supplies wrapped and packed in a primary container.

d) Supplies packed direct into an outer container with protection against physical damage.

C-2. Non-waterproof Packages With Temporary Protective

a) Metallic items with their surfaces protected with appropriate protectives, wrapped and enclosed in a primary container.

b) Paper, cork, felt, rubber and leather items protected with appropriate preservatives, wrapped and enclosed in a primary container.

APPENDIX D

(*Clause* 5.1)

METHODS OF WATERPROOF PACKAGING (SERIES B)

D-1. Metallic items or assemblies with surfaces protected with appropriate protectives, wrapped and enclosed in a waterproof barrier incorporated inside the primary container.

D-2. Metallic items or assemblies with surfaces protected with appropriate protectives, wrapped and enclosed in a waterproof barrier applied outside the primary container.

D-3. Unpreserved items wrapped and enclosed in a waterproof barrier.

D-4. Unpreserved items enclosed in a polythene bag or envelope.

APPENDIX E

(*Clause* 5.1)

METHODS OF WATER VAPOUR-PROOF PACKAGING (SERIES C)

E-1. Metallic items or assemblies with surfaces protected with appropriate protective, wrapped and packed in a carton or rigid box with a covering of metal foil, laminated sheet or polythene film.

E-2. Unpreserved items or assemblies packed in a carton or rigid box with a covering of metal foil, laminated sheet, or polythene film.

E-3. Metallic items or assemblies with surfaces protected with appropriate protective, wrapped, packed in a carton or rigid box with a covering of carton wrap and wax dipped.

E-4. Unpreserved items or assemblies packed in a carton or rigid box with a covering of carton wrap and wax dipped.

E-5. Metallic items or assemblies with surfaces protected with appropriate protective, wrapped and packed in an aluminium container.

E-6. Unpreserved items or assemblies, wrapped and packed in an aluminium container.

E-7. Metallic items or assemblies, with surface protected with appropriate protective, wrapped in grease resisting, mouldable, waxed and wax coated wrapping.

E-8. Metallic items or assemblies with surfaces protected with appropriate protective, enclosed in a polythene film or metal foil laminated floating bag, and packed in a primary container.

E-9. Unpreserved items or assemblies enclosed in a polythene film or metal foil laminated floating bag and packed in a primary container.

APPENDIX F

(*Clause* 5.1)

METHODS OF DESICCATED PACKAGING (SERIES D)

F-1. Supplies wrapped and packed with desiccant in a wrapped and wax coated carton or rigid box.

F-2. Supplies wrapped and packed with desiccant in a carton or rigid box with a covering of polythene film.

F-3. Supplies wrapped and packed with desiccant into a carton or rigid box with a covering of foil, metal, laminated sheet.

F-4. Supplies packed with desiccant in a seamless cylindrical aluminium container.

F-5. Supplies packed with desiccant in a water-vapour resistant bag or envelope.

F-6. Supplies packed with desiccant into a floating bag inside a container.

F-7. Supplies packed with desiccant into an inner container with a covering of metal foil, laminated sheet, and packed into an outer container.

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